UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS TX 75202-2733

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MEMORANDUM

Summary of Alternatives Screening and Review for the Wilcox Oil Company Superfund Site Source Control Action

FROM: Katrina Higgins-Coltrain, Remedial Project Manager
LA/NM/OK Section (6SF-RL)

TO: Wilcox Oil Company Site Administrative File
OK0001010917

THRU: Mike Hebert, Remedial Project Manager
LA/NM/OK Section (6SF-RL)

Laura Stankosky, Remedial Project Manager
LA/NM/OK Section (6SF-RL)

Gary Baumgarten, Remedial Project Manager
AR/TX Section (6SF-RA)

Vince Malott, Remedial Project Manager
Remedial Branch (6SF-R)

Blake Atkins, Section Chief
LA/NM/OK Section (6SF-RL)

Purpose

The purpose of this memorandum is to document the screening process used to identify early actions that can be taken before completion of the Remedial Investigation/Feasibility Study (RI/FS) to address source areas at the Wilcox Oil Company Superfund Site. Consistent with the National Contingency Plan (NCP) [40 CRF § 300.430(a)(1)], the technologies that can be used for an early action are limited in scope to addressing the tank waste and the lead additive source areas identified during the ongoing remedial investigation (RI).

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Presumptive remedies were developed by the U.S. Environmental Protection Agency (EPA) to streamline the selection of cleanup methods for certain categories of sites by narrowing the consideration of treatment technologies or remediation approaches that have a proven track record in the Superfund program (EPA, 1997). The presumptive remedies identified in the *Presumptive Remedy for Metals-in-Soil Sites* (EPA, 1999) and the *Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites* (EPA, 1995b) are appropriate for use at the Wilcox Oil Company Site based on the contaminant characteristics found in the source material at the site. In addition, these same technologies have been successfully applied for source areas at similar Superfund Sites in Region 6 such as Imperial Refining, Hudson Refining, Tulsa Fuels, and during the Removal Action completed in 2017at the site.

Relevant RI data can be summarized for the source material, and the applicable treatment technologies are few and straightforward while following the presumptive remedy guidance. Although documentation could be presented in the early action decision document, the EPA is summarizing the screening process in this technical memorandum for clarity and using the early action decision document for the evaluation of alternatives against the nine criteria.

Interim and Early Action Support

The NCP [40 CRF § 300.430(a)(1)] states, "Remedial actions are to be implemented as soon as site data and information make it possible to do so." This is further clarified in the preamble to the NCP (Federal Register, 1990),

EPA expects to take early action at sites where appropriate and to remediate sites in phases using operable units as early actions to eliminate, reduce or control the hazards posed by a site or to expedite the completion of total site cleanup. In deciding whether to initiate early actions. EPA must balance the desire to definitively characterize site risks and analyze alternative remedial approaches for addressing those threats in great detail with the desire to implement protective measures quickly.

EPA promotes the responsiveness and efficiency of the Superfund program by encouraging action prior to or concurrent with conduct of an RI/FS as information is sufficient to support a remedy selection. These actions may be taken under removal or remedial authorities as appropriate.

The NCP acknowledges that the final remedial investigation (RI), feasibility study (FS), and risk assessment may not be complete and encourages action prior to and concurrent with these processes. In such cases, data from the ongoing RI is used to support the early action and evaluate an appropriate set of alternatives for the limited early action.

Background

On May 24, 2013, EPA proposed the site to the National Priorities List (NPL). On December 12, 2013, the site officially became a Federal Superfund Site (EPA Identification No. OK0001010917), when it was added to the NPL.

The EPA and the Oklahoma Department of Environmental Quality (ODEQ) have conducted multiple investigations at the site since 1994, including site assessments and expanded site investigations. Currently, the remedial investigation is ongoing to define nature and extent of contamination, evaluate the potential human health and ecological risks, and identify potential remediation technologies. No final RI, risk assessments or FS have been completed.

General Description

After the refinery operations ceased and most of the tanks and buildings were demolished and sold for scrap, the property was sold to private interests (ODEQ, 1994). Beginning in 1975 with the construction of the church and parsonage, private residences were constructed on six parcels of land that were part of the former refinery operations, with the most recent being constructed in 2003/2004. One of these residences is the former office/lab building associated with the refinery. As a result, there are seven residential properties located within former tank or refinery operation areas, three of which are occupied and one periodically rented. In addition, two occupied residential properties on the eastern portion of the site (East Tank Farm) use water from domestic/private wells (ODEQ, 1994).

The facility can be divided into five (5) major former operational areas (Figure 1): the Wilcox and Lorraine Process Areas, the East and North Tank Farms, and the Loading Dock Area (EPA, 2016). An active railroad divides the two former process areas and product storage areas. Historical waste management practices are not known at this site. Historical Sanborn maps are available for some areas of the site and were reviewed to identify the possible locations where contamination may have originated (Figure 1). Waste associated with crude oil refining may include the following: petroleum-related compounds, tank sludges/solids, crude oil, fuel oil, gas oil, petroleum distillate, kerosene, benzene, petroleum ether, brine, acid and caustic sludge, heavy metals, coke, sulfur compounds, solvents, and naturally-occurring radioactive material. Hexavalent chromium may be present where activities associated with cooling towers and cooling ponds took place (EPA, 2016).

Source Characteristics

Source material is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, air, or acts as a source for direct exposure (EPA, 1991).

Site investigation activities identified two source materials: tank waste and the lead additive area. Table 1 provides a summary of detected contaminants, and Table 2 provides a summary of estimated volumes.

- Tank Waste: The tank waste is an oily tar-like viscous liquid. Results for samples collected from the tank waste are as high as 3,660 milligrams per kilogram (mg/kg) lead, 20 mg/kg Benzo(a)pyrene, 1,400 mg/kg 2-methylnaphthalene, and 875,000 mg/kg total petroleum hydrocarbons (Table 1). The tank waste is not a listed hazardous waste, and data results indicate that the tank waste is not a characteristic hazardous waste.

The Hazard Ranking System (HRS; EPA, 2013) document identified ten (10) potential source areas with associated releases of polycyclic aromatic hydrocarbons (PAHs) and metals to the nearby wetlands and Sand Creek. The RI investigation verified the presence of tank waste at eight (8) former tank areas and one separation pit (Figure 1). Due to its proximity to a residential home, the EPA performed a removal action in October 2017, at one of the former tank locations to address approximately 1,349 tons of tank waste through excavation and offsite disposal. The remaining former tank areas (7) and separation pit contain source materials that were assessed for early action due to the presence of high contaminant concentrations, proximity to residential homes, and the proximity to the Sand Creek.

- Lead additive area: This area is denuded of vegetation and covered by silty sparkling sand and a white, salt-like substance. Lead results for samples collected from this area are as high as 55,049 to 105,000 mg/kg. The lead additive area is not a listed hazardous waste; however, data results indicate that the lead additive area is a characteristic hazardous waste due to the leaching of lead. The lead additive area is being proposed for early action due to the presence of high contaminant concentrations and migration pathways to the creek.

A total of 9 source areas are identified for source control action: two (2) are within 225 - 300 feet of a residence, 5 are within 225 feet of either Sand Creek or the East Tributary that drains to Sand Creek, 1 is located on a residential property, and the last is located within a cow pasture. Fencing currently restricts and limits direct exposure for the short-term.

Remedial Action Objectives

The remedial action objectives for the tank waste and lead additive area are to

- Prevent ingestion and dermal contact exposure to human and ecological receptors through the removal of tank waste to reach a target health-based concentration of 0.11 mg/kg benzo(a)pyrene and the removal of the lead additive area to reach a target health-based concentration of 800 mg/kg lead.
- Prevent contaminant migration to soil, sediment, and indoor air through the removal of tank waste to reach a target health-based concentration of 0.11 mg/kg benzo(a)pyrene and the removal of the lead additive area to reach a target health-based concentration of 800 mg/kg lead.
- Removal of source materials to eliminate and prevent further degradation of the surrounding environment as a result of exposure to or migration from tank waste and the lead additive area.

Presumptive Remedy Review

Based on the nature and contaminant mixture of the source materials identified at the site, it is appropriate to use the presumptive remedies developed by EPA. During the review process, additional resources were also reviewed (Platinum, 2002; EPA, 1995a; EPA, 1988).

Tank Waste: The *Presumptive Remedies for Soils, Sediments, and Sludges at Wood Treater Sites* (EPA, 1995b) is directed at sites that are contaminated with wood treater preservatives, of which creosote is one. Creosote is an oily, translucent brown to black liquid that is a complex mixture of organic compounds containing approximately 85% PAHs, 10% phenolic compounds, and 5% nitrogen-, sulfur- or oxygen-containing heterocycles. The tank waste is of similar consistency being a viscous oil-tar liquid, and is of similar composition containing primarily PAHs (Table 1) and to a lesser extent simple non-halogenated aromatics, including ethylbenzene, toluene, and xylene.

Lead Additive Area: The *Presumptive Remedy for Metals-in-Soil Sites* (EPA, 1999) is directed at sites or areas that primarily contain metals in soil or related media having similar characteristics. It applies to soil characterized as loose material on the surface and in the subsurface of the earth consisting of mineral grains and organic materials in varying proportions. The lead additive area is contaminated with lead and is a loose material found at the surface or just below.

In addition to the presumptive remedy approach, the technology screening matrix (Figure 2; Platinum, 2002) developed by the Federal Remediation Technology Roundtable was reviewed for potential treatment technologies applicable to tank waste and metal-contaminated soil. Other guidance that assisted with this review include the *Technology Screening Guide for Treatment of CERCLA Soils and Sludges* (EPA, 1988) and *Contaminants and Remedial Options at Selected Metal-Contaminated Sites* (EPA 1995a).

Screening of Technologies and Selection of Representative Technologies

Based on a review of the presumptive remedies, technology screening matrix, guidance documents, site conditions, early action contaminants of potential concern (COPC), and the early action remedial action objectives, a list of remedial technologies and process options commonly discussed among the various resources were identified (Tables 3 and 4). Each process option was further screened based on effectiveness and implementability in relation to site conditions and COPC data. Cost is designated high, moderate, and low, which compares relative costs within the same remedial technology. Through this process, remedial options were further reduced to a limited number of technologies to be considered as early action alternatives.

Tables 3 and 4 summarize the remedial technologies and process options considered, compares the remedial technologies and process options against the three screening criteria, and identifies those remedial technologies and process options screened from further consideration as early actions and those selected for consideration as early actions. Grey highlighted technologies are screened from further consideration.

Technologies Screened from further Consideration

All treatment technologies for the tank waste have been screened out from further consideration as an early action. The tank waste is not a listed hazardous wastes and is not identified as a characteristic hazardous wastes. As such, land disposal restriction are not applicable and treatment is not necessary prior to disposal. In addition, because one

source material is organic and one source material is inorganic, a combination of treatment technologies is needed and management of the residual could potentially include a third technology (e.g., containment or offsite disposal). Management of the tank source materials under one technology is more efficient, easier to implement, and more cost effective.

Although data indicate that the lead additive area may contain lead concentrations that are amenable to reclamation, the volume of material is small and the organic and moisture content may prohibit efficient lead reclamation. Based on site data, the entire estimated volume is not expected to contain lead at concentrations supporting reclamation; therefore, only a limited volume, estimated at 2,269 cubic yards, would potentially qualify for reclamation. Due to economies of scale, reclamation/recovery technologies generally work best for a continuous feed of large volumes of metals (EPA, 1999).

The bioremediation, thermal and immobilization treatment technologies are not practical for the tank source areas since this will require either multiple treatment units for the dispersed source areas, or source excavation and consolidation into a larger waste cell or treatment unit. Use of these treatment options will also require detailed treatability studies to determine the suitable conditions for treatment. There is uncertainty in treatment efficiency, treatment construction, and operation timeframe. In addition, the amount of residual remaining after treatment (EPA 1995b; EPA 1988) is unknown and could result in management and handling of multiple treatment trains. Implementation of these remedies requires a large portion of the site for equipment, material staging, material mixing and handling, and material treatment. This would limit and restrict remaining investigation work. Since the tank waste is neither a listed hazardous waste nor a characteristic hazardous waste treatment is not needed, and the cost, time, and effort necessary to implement these options outweighs the protection benefit gained when compared to other alternatives.

The containment option involving the use of a vegetation cap has been eliminated from further consideration as an option for the early action. Since the tank waste will not be treated, the use of a membrane cap provides an additional layer of protection against water infiltration, contaminant migration, and vapor intrusion.

Technologies Screened for further Consideration

Excavation and Containment technologies are retained for consideration as early actions. In addition, immobilization for the lead additive area is retained. The excavation technology removes the sources from the site and eliminates the migration and exposure potential at a reasonable cost. The containment technology consolidates sources into one central location for containment which eliminates the potential for migration and exposure at a reasonable cost. Due to the leaching of lead and the identification of this source material as a characteristic waste, it will need to be treatment to meet land disposal restriction whether disposed offsite or contained onsite.

Review of the technology screening matrix shows that these technologies are above

average for relative overall costs and performance when compared with other technologies (Figure 2). The application of these technologies is also consistent with prior remedial action work at the Imperial Refining, Tulsa Fuels, and Hudson Refining sites as well as the Removal Action performed at this site in 2017. These technologies have been proven effective in meeting the RAOs and receiving support from the community and State.

References

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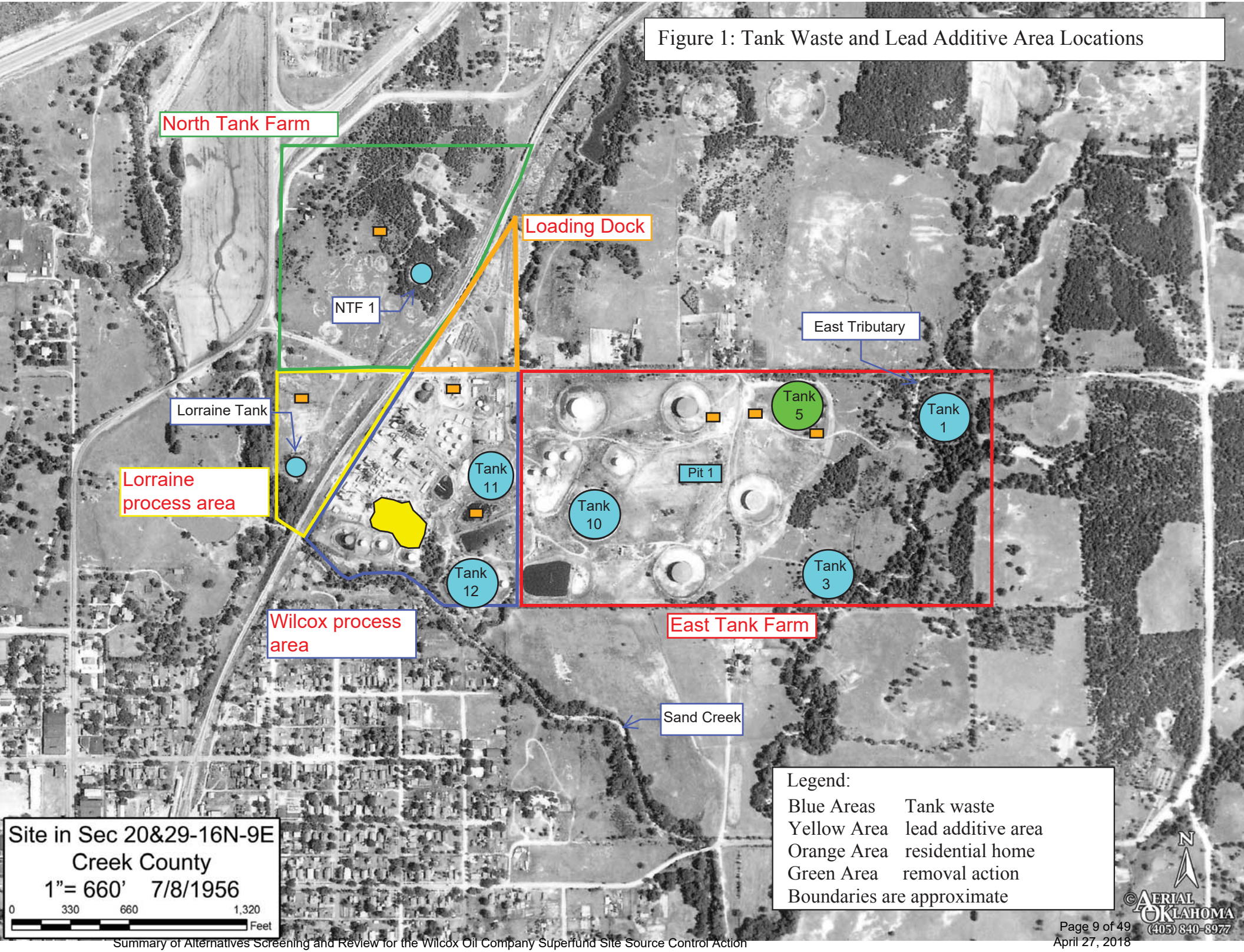
Figure 1: Tank Waste and Lead Additive Area Locations
North Tank Farm
Loading Dock
NTF 1
East Tributary
Lorraine Tank
Tank 5
Tank 1
Lorraine process area
Tank 11
Pit 1
Tank 10
Tank 12
Tank 3
Wilcox process area
East Tank Farm
Sand Creek
Site in Sec 20&29-16N-9E
Creek County
1"= 660' 7/8/1956
0 330 660 1,320 Feet
Legend:
Blue Areas Tank waste
Yellow Area lead additive area
Orange Area residential home
Green Area removal action
Boundaries are approximate
N
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TABLE 3-2: TREATMENT TECHNOLOGIES SCREENING MATRIX

Rating Codes
- ● Above Average
- ◑ Average
- ○ Below Average
- N/A - "Not Applicable"
- I/D - "Insufficient Data"
- ◈ - Level of Effectiveness highly dependent upon specific contaminant and its application

	Development Status	Treatment Train	Relative Overall Cost & Performance					Availability	Nonhalogenated VOC's	Halogenated VOC's	Nonhalogenated SVOC's	Halogenated SVOC's	Fuels	Inorganics	Radionuclides	Explosives
			O&M	Capital	System Reliability & Maintainability	Relative Costs	Time									
Soil, Sediment, Bedrock, and Sludge																
3.1 In Situ Biological Treatment																
4.1 Bioventing	●	●	●	●	●	●	◑	●	●	◈	●	○	●	○	◈	○
4.2 Enhanced Bioremediation	●	●	○	◑	◑	●	◑	●	●	●	●	◈	●	◈	◈	●
4.3 Phytoremediation	●	●	●	●	○	●	○	◑	◑	◑	◑	◈	◑	◑	○	○
3.2 In Situ Physical/Chemical Treatment																
4.4 Chemical Oxidation	●	●	○	◑	◑	◑	●	●	◑	◑	○	◑	○	◈	○	◑
4.5 Electrokinetic Separation	●	○	○	◑	◑	○	◑	◑	◑	◑	◑	◑	○	●	◑	○
4.6 Fracturing	●	◑	◑	○	◑	◑	◑	●	◑	◑	◑	◑	◑	○	○	○
4.7 Soil Flushing	●	●	○	◑	◑	◑	◑	●	●	●	◑	◑	◑	●	○	○
4.8 Soil Vapor Extraction	●	○	○	◑	●	●	◑	●	●	●	○	○	●	○	○	○
4.9 Solidification/Stabilization	●	●	◑	○	●	●	●	●	○	○	◑	◑	○	●	●	○
3.3 In Situ Thermal Treatment																
4.10 Thermal Treatment	●	○	○	○	●	◑	●	●	●	●	●	●	●	○	○	○
3.4 Ex Situ Biological Treatment (assuming excavation)																
4.11 Biopiles	●	●	●	●	●	●	◑	●	●	●	◑	◈	●	◈	○	○
4.12 Composting	●	●	●	●	●	●	◑	●	◑	◑	◑	◈	●	○	○	●
4.13 Landfarming	●	●	●	●	●	●	◑	●	◑	◑	●	◑	●	○	○	◈
4.14 Slurry Phase Biological Treatment	●	○	○	○	◑	◑	◑	●	◑	●	●	◈	●	◈	○	●
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)																
4.15 Chemical Extraction	●	○	○	○	◑	◑	◑	●	◑	◑	●	●	◑	●	◑	○
4.16 Chemical Reduction /Oxidation	●	◑	◑	○	●	◑	●	●	◑	◑	◑	◑	◑	●	○	◑
4.17 Dehalogenation	●	◑	○	○	○	○	◑	◑	○	●	○	●	○	○	○	◑
4.18 Separation	●	◑	○	◑	●	◑	●	●	◑	◑	◑	◑	○	◑	○	○
4.19 Soil Washing	●	○	○	○	●	◑	●	●	◑	◑	◑	◑	◑	◑	○	○
4.20 Solidification/Stabilization	●	●	◑	○	●	●	●	●	○	○	◑	◑	○	●	●	○
3.6 Ex Situ Thermal Treatment (assuming excavation)																
4.21 Hot Gas Decontamination	○	●	○	○	●	●	●	◑	○	○	○	○	○	○	○	○
4.22 Incineration	●	●	○	○	◑	○	●	●	●	●	●	●	●	○	○	●
4.23 Open Burn/Open Detonation	●	●	○	○	●	●	●	●	○	○	○	○	○	○	○	●
4.24 Pyrolysis	●	●	○	○	○	○	●	●	◑	◑	●	●	◑	○	○	○
4.25 Thermal Desorption	●	●	○	○	◑	◑	●	●	●	●	●	●	●	○	○	●
3.7 Containment																
4.26 Landfill Cap	●	●	◑	○	●	●	○	●	◑	◑	◑	◑	◑	◑	○	◑
4.27 Landfill Cap Enhancements/Alternatives	●	●	◑	○	●	●	○	●	◑	◑	◑	◑	◑	◑	○	◑
3.8 Other Treatment																
4.28 Excavation, Retrieval, Off-Site Disposal	●	●	●	●	●	◈	●	●	◑	◑	◑	◑	◑	◑	○	◑
Ground Water, Surface Water, and Leachate																
3.9 In Situ Biological Treatment																
4.29 Enhanced Bioremediation	●	●	○	◑	◑	●	◈	●	●	◈	●	◈	●	◈	○	◑
4.30 Monitored Natural Attenuation	●	●	○	◑	◑	●	◈	●	●	◑	◑	◑	●	○	○	○
4.31 Phytoremediation	●	●	●	●	○	●	○	◑	◑	◑	◑	◑	◑	◈	○	○
3.10 In Situ Physical/Chemical Treatment																
4.32 Air Sparging	●	●	●	●	●	●	●	●	●	◑	◑	◑	●	○	○	○
4.33 Bioslurping	●	◑	●	●	◑	●	◑	●	◑	◑	◑	●	●	◑	○	○
4.34 Chemical Oxidation	●	●	○	◑	◑	◑	●	●	◑	◑	○	◑	○	◈	○	◑
4.35 Directional Wells (enhancement)	●	●	◑	○	◑	◑	◑	●	◑	◑	◑	◑	◑	◑	○	◑
4.36 Dual Phase Extraction	●	○	○	○	◑	◑	◑	●	●	●	●	●	●	○	○	○
4.37 Thermal Treatment	●	○	○	○	◑	◑	●	●	◑	●	●	●	●	○	○	○
4.38 Hydrofracturing Enhancements	●	◑	●	●	●	◑	◑	●	◑	◑	◑	◑	◑	◑	○	◑
4.39 In-Well Air Stripping	●	◑	◑	○	◑	◑	○	●	◑	◑	◑	○	◑	○	○	○
4.40 Passive/Reactive Treatment Walls	●	●	◑	○	●	◑	○	●	●	●	●	●	◑	◈	○	●
3.11 Ex Situ Biological Treatment																
4.41 Bioreactors	●	●	◑	○	◑	●	◑	●	●	●	●	◈	●	○	○	●
4.42 Constructed Wetlands	●	●	◑	○	◈	◑	◈	○	◑	◑	◑	◈	◑	●	○	●
3.12 Ex Situ Physical/Chemical Treatment (assuming pumping)																
4.43 Adsorption/ Absorption	●	●	○	◑	◑	○	○	●	◑	◑	◑	◑	○	●	◈	○
4.44 Advanced Oxidation Processes	●	◑	○	○	◑	◑	○	●	●	●	●	●	●	◈	◈	●
4.45 Air Stripping	●	◑	○	◑	●	●	○	●	●	●	○	○	○	○	○	○
4.46 Granulated Activated Carbon/Liquid Phase Carbon Adsorption	●	◑	○	◑	●	◑	○	●	●	●	●	●	●	◈	○	◈
4.47 Groundwater Pumping/Pump & Treat	●	◑	○	○	●	○	○	●	◑	◑	◑	◈	◑	◑	○	◑
4.48 Ion Exchange	●	◑	○	○	●	◑	○	●	○	○	○	○	○	●	◑	○
4.49 Precipitation/Coagulation/Flocculation	●	◑	◑	○	●	◑	○	●	○	○	○	○	○	●	◑	○
4.50 Separation	●	◑	○	○	●	○	●	●	●	●	●	●	●	◈	◈	○
4.51 Sprinkler Irrigation	●	●	●	●	●	○	○	●	●	●	○	○	○	○	○	○
3.13 Containment																
4.52 Physical Barriers	●	●	◑	○	●	●	○	●	●	●	●	●	●	●		●
4.53 Deep Well Injection	●	●	●	●	◑	●	○	●	◑	◑	◑	◑	◑	◑	◑	◑
3.14 Air Emissions/Off-Gas Treatment																
4.54 Biofiltration	●	N/A	●	●	◈	●	●	○	●	◈	◈	◈	●	○	I/D	◈
4.55 High Energy Destruction	○	N/A	I/D	I/D	○	◑	I/D	◑	●	●	●	●	●	◑	I/D	○
4.56 Membrane Separation	○	N/A	I/D	I/D	○	◑	I/D	◑	●	●	◑	◑	◑	○	I/D	◑
4.57 Oxidation	●	N/A	●	●	●	●	I/D	●	●	●	●	●	●	○	I/D	◑
4.58 Scrubbers	●	N/A	◑	○	●	●	I/D	●	○	○	○	○	○	●	I/D	I/D
4.59 Vapor Phase Carbon Adsorption	●	N/A	●	●	●	●	I/D	●	●	●	●	●	●	◑	I/D	●

TABLE 3-1: DEFINITION OF SYMBOLS USED IN THE TREATMENT TECHNOLOGIES SCREENING MATRIX

Factors		● Above Average	◑ Average	○ Below Average	Other
Development Status Scale status of an available technology		Implemented as part of the final remedy at multiple sites, well documented, understood, etc.	Has been implemented at full scale but still needs improvements, testing, etc.	Not been fully implemented but has been tested (pilot, bench, lab scale) and is promising	◈ Level of Effectiveness highly dependent upon specific contaminant and its application/ design
Treatment Train Is the technology only effective as part of the treatment train?		Stand-alone technology (not complex in terms of number of media/treatment technologies, maybe one "routine" technology in addition)	Relatively simple (two-car train or so), and well understood, widely applied, etc.	Complex (more technologies, media to be treated, generates excessive waste, etc.)	
Relative overall cost and performance	**O&M** Operation and Maintenance Intensive	Low degree of O&M intensity	Average degree of O&M intensity	High degree of O&M intensity	
	Capital Capital Intensive	Low degree of capital investment	Average degree of capital investment	High degree of capital investment	
	System Reliability /Maintainability The expected range of demonstrated reliability and maintenance relative to other effective technologies	High reliability and low maintenance	Average reliability and average maintenance	Low reliability and high maintenance	N/A "Not Applicable"
	Relative Costs Design, construction, and operations and maintenance (O&M) costs of the core process that defines each and pre-and post-treatment	Low degree of general costs relative to other options	Average degree of general costs relative to other options	High degree of general costs relative to other options	I/D "Insufficient Data"
	Time Time required to clean up a "standard" site using the technology — in situ soil	Less than 1 year	1-3 years	More than 3 years for in situ soil	
	ex situ soil	Less than 0.5 year	0.5-1 year	More than 1 year for ex situ soil	
	groundwater	Less than 3 years	3-10 years	More than 10 years for water	
Availability Number of vendors that can design, construct, and maintain the technology		More than 4 vendors	2-4 vendors	Fewer than 2 vendors	
Contaminants Treated Contaminants are classified into eight groups: - Nonhalogenated VOCs - Halogenated VOCs - Nonhalogenated SVOCs - Halogenated SVOCs - Fuels - Inorganics - Radionuclides - Explosives		Effectiveness Demonstrated at Pilot or Full Pilot or Full Scale	Limited Effectiveness Demonstrated at Pilot or Full Scale	No Demonstrated Effectiveness at Pilot or Full Scale	Same as above

Source: Platinum International, Inc. 2002. Remediation Technologies Screening Matrix and Reference Guide, 4th Edition. Prepared for the U.S. Army Environmental Center. https://frtr.gov/matrix2/top_page.html. January.

Table 1: Comparison of site data to Health Based Screening Levels[1]				
Source Material	**Contaminant of Potential Concern**	**Data Results (mg/kg)**	**Health-Based Screening Level (mg/kg)**	**Health-Based Screening Level Basis**
Lead Additive Area	Lead	105,000	800	Protection of blood lead levels in workers
Waste Material	Benzo(a)anthracene	12	1.1	Residential Cancer Screening Number at 10-6 Risk
	Benzo(a)pyrene	12	0.11	Residential Cancer Screening Number at 10-6 Risk
	Benzo(b)fluoranthene	20	1.1	Residential Cancer Screening Number at 10-6 Risk
	Indeno(1,2,3-cd)pyrene	4.4	1.1	Residential Cancer Screening Number at 10-6 Risk
	2-methylnaphthalene	1400	240	Residential Non-cancer Screening Number at Hazard Index=1
	Naphthalene	14	3.8	Residential Cancer Screening Number at 10-6 Risk
1- Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2017 mg/kg=milligram per kilogram Data presented are the highest recorded results.				

Table 2: Areas of Remediation – Estimated Volume	
Area Name	**Volume Estimated (cubic yards)**
Lorraine Waste	953
Lead Additive Area	2,269
Tank 1	3,323
Tank 3	3,608
NTF-1	818
Tank 10	9,902
Tank 11	431
Tank 12	4,788
Pit 1	4,270
Total	30,362 (5 Acres)
NTF=north tank farm	

Table 3: Technology Screening for the Lead Additive Area						
	General Response	**Remedial Technology**	**Process Option**	**Cost[#]**	**Effectiveness**	**Implementability**
Lead Additive Area	Removal	Physical Removal	Excavation	--	Pros: permanent removal; unrestricted use; no long-term maintenance or administrative controls; eliminates migration Cons: combine with treatment technology;	Pros: commercially available; demonstrated technology; landfills within 50 miles; short construction period (2-3 months) Cons: hauling through community; potential worker and community exposure to dust; land disposal restrictions
	Containment	Capping	Clay and Membrane	moderate	Pros: mitigates migration; one consolidated area; water infiltration layer for mitigation of leaching Cons: long-term maintenance needed; 5-yr reviews; administrative controls; land use restrictions; organic waste not treated, yet can be contained	Pros: commercially available; demonstrated technology; land disposal restrictions; short construction/consolidation period (4-5 months) Cons: location will compromise current land use and remaining RI; potential worker and community exposure to dust; administrative controls enforcement
			Clay and Vegetation	low	Pros: mitigates migration; one consolidated area; Cons**:** long-term maintenance needed; 5-yr reviews; administrative controls; land use restrictions; soil/vegetative cover may not restrict water to mitigate leaching; no organic waste treatment;	Pros: commercially available; demonstrated technology; land disposal restrictions; short construction period (4-5 months) Cons: location will compromise current land use and remaining RI investigation; potential worker and community exposure to dust; administrative controls enforcement

Notes: Grey cells: screened from further evaluation TCLP: toxicity characteristic leaching procedure #Cost: see Appendix A

Resources: --: no comparison/sole process reviewed

1. Presumptive remedy for Metals-in-Soil Sites, Office of Solid Waste and Emergency Response, EPA-540-F-98-054, OSWER-93550.0-72FS, September 1999.
2. Implementing Presumptive Remedies: A Notebook of Guidance and Resource Materials, Office of Solid Waste and Emergency Response, EPA-540-R-97-029, OSWER 9378.0-11, October 1997.
3. Contaminants and Remedial Options at Selected Metal-Contaminated Sites, Office of Research and Development, EPA/540/R-95/512, July 1995a.

Table 3: Technology Screening for the Lead Additive Area (continued)						
	General Response	**Remedial Technology**	**Process Option**	**Cost[#]**	**Effectiveness**	**Implementability**
Lead Additive Area	Treatment	Physical and/or Chemical Treatment	Immobilization	low	Pros: effective for metals; minimizes migration; meets land disposal restrictions Cons: residual management either onsite or offsite disposal; presence of organics/phenols could reduce effectiveness; metals treatment necessary as waste is a characteristic hazardous waste;	Pros: commercially available; demonstrated technology; meets land disposal restrictions Cons: increased volume due to additives; may need specialized vendors, additives, and equipment; treatability study needed; extended construction/treatment period (4-5 months); potential worker exposure and materials (i.e., source material and additives) handling;
			Reclamation	high	Pros: lead concentrations are high Cons: small volume/quantity; high moisture content, presence of sulfur compounds and phenols could reduce removal efficiency; not economically viable (i.e., technology costs exceed benefit)	Pros: reclaimed resource Cons: specialized vendors and equipment; construction/treatment period unknown; specialized reclamation facility limited locations; transportation cost prohibitive

Notes: Grey cells: screened from further evaluation TCLP: toxicity characteristic leaching procedure #Cost: see Appendix A

Resources: --: no comparison/sole process reviewed

1. Presumptive remedy for Metals-in-Soil Sites, Office of Solid Waste and Emergency Response, EPA-540-F-98-054, OSWER-93550.0-72FS, September 1999.
2. Implementing Presumptive Remedies: A Notebook of Guidance and Resource Materials, Office of Solid Waste and Emergency Response, EPA-540-R-97-029, OSWER 9378.0-11, October 1997.
3. Contaminants and Remedial Options at Selected Metal-Contaminated Sites, Office of Research and Development, EPA/540/R-95/512, July 1995a.

Table 4: Technology Screening for the Tank Waste						
	General Response	**Remedial Technology**	**Process Option**	**Cost#**	**Effectiveness**	**Implementability**
Tank Waste	Removal	Physical Removal	Excavation	--	Pros: permanent removal; unrestricted use; no long-term maintenance; no administrative controls; mitigates migration Cons: waste not treated, however treatment is not necessary	Pros: commercially available; demonstrated technology; no land disposal restrictions; landfills within 50 miles; short construction period (2-3 months) Cons: hauling through community; potential worker and community exposure to dust
	Containment	Capping	Clay and Membrane	moderate	Pros: water infiltration layer for mitigation of leaching and vapor intrusion; mitigates migration; one consolidated area Cons: long-term maintenance needed; 5-yr reviews; administrative controls; land use restrictions; waste not treated, however treatment is not necessary	Pros: commercially available and demonstrated technology; no land disposal restrictions; short construction/consolidation period (4-5 months) Cons: location will compromise current land use and remaining RI; potential worker and community exposure to dust; administrative controls enforcement
			Clay and Vegetation	Low	Pros: mitigates migration; one consolidated area Cons: long-term maintenance needed; 5-yr reviews; administrative controls; land use restrictions; soil/vegetative cover may not restrict water to mitigate leaching or restrict vapor intrusion; waste not treated;	Pros: commercially available; demonstrated technology; no land disposal restrictions; short construction/ consolidation period (4-5 months) Cons: location will compromise current land use and remaining RI investigation; potential worker and community exposure to dust; administrative controls enforcement

Notes: TPH = total petroleum hydrocarbon RI = remedial investigation #Cost: See Appendix A Grey cells: screened from further evaluation

Resources: --: no comparison/sole process reviewed

1. Technology Screening Guide for Treatment of CERCLA Soils and Sludges, Office of Solid waste and Emergency Response, EPA/540/2-88/004, September 1988.
2. Implementing Presumptive Remedies: A Notebook of Guidance and Resource Materials, Office of Solid Waste and Emergency Response, EPA-540-R-97-029, OSWER 9378.0-11, October 1997.
3. Presumptive Remedies for Soils, sediments, and Sludges at Wood Treater Sites, Office of Solid Waste and Emergency Response, EPA 540-R-95-128, OSWER 9200.5-162, December 1995b.

Table 4: Technology Screening for the Tank Waste (continued)						
	General Response	**Remedial Technology**	**Process Option**	**Cost[#]**	**Effectiveness**	**Implementability**
Tank Waste	Treatment	Physical or Chemical	Immobilization	moderate	Pros: proven effective on organics; mitigates migration Cons: necessary to combine with other technologies to reach full reduction; efficiency limited by high TPH content; residual management onsite or offsite disposal; administrative controls and land use restrictions; treatment not necessary as waste is not a listed or characteristic hazardous waste; combine with additional technology	Pros: commercially available; demonstrated technology; no land disposal restrictions; Cons: in-situ will compromise current land use and remaining RI investigation; treatability studies required; may need specialized equipment; extended construction/ treatment period (4-5 months); potential worker exposure and materials (i.e., source material and additives) handling; combine with additional technology
		Thermal	Incineration	High	Pros: effective in treating organics; eliminates migration Cons: cost far exceeds risk reduction benefit when compared with other technologies; treatment not necessary as waste is not a listed or characteristic hazardous waste; potential for residual management onsite or offsite disposal; onsite management of residuals will need administrative controls and land use restrictions; potential off-gas production;	Pros: commercially available; demonstrated technology Cons: implementation location will compromise current land use and remaining RI investigation; treatability studies required; significant materials handling; specialized equipment and operators; extended construction/ treatment period (6-7 months); viscous nature may require pre-treatment; potential community opposition; potential combination with other technology for residual management; onsite management of residuals will need administrative controls enforcement
			Low Thermal Desorption	High	Pros: effective in treating organics; eliminates migration	Pros: commercially available; demonstrated technology

Table 4: Technology Screening for the Tank Waste (continued)						
	General Response	**Remedial Technology**	**Process Option**	**Cost[#]**	**Effectiveness**	**Implementability**
Tank Waste	Treatment	Thermal	Low Thermal Desorption	High	Cons: cost far exceeds risk reduction benefit when compared with other technologies; treatment not necessary as waste is not a listed or characteristic hazardous waste; potential for residual management onsite or offsite disposal; onsite management of residuals will need administrative controls and land use restrictions; potential off-gas production;	Cons: implementation location will compromise current land use and remaining RI investigation; treatability studies required; significant materials handling; specialized equipment and vendor; extended construction/ treatment period (6-7 months); viscous nature may require pre-treatment; potential community opposition; potential combination with other technology for residual management; onsite management of residuals will need administrative controls enforcement
		Biological	Land Farming	low	Pros: partially effective on high levels of organics; eliminates migration Cons: residual management onsite or offsite disposal; administrative controls; land use restrictions; treatment not necessary as waste is not a listed or characteristic hazardous waste; limited effectiveness on non-aqueous phase; potential off-gas production; potential for residual management onsite or offsite disposal	Pros: generally accepted by community; no specialized equipment Cons: location will compromise current land use and remaining RI investigation; extended construction/ treatment period (≥ 10-12 months); significant materials handling; treatability studies required; viscous nature may require pre-treatment

Notes: TPH = total petroleum hydrocarbon RI = remedial investigation #Cost: See Appendix A Grey cells: screened from further evaluation

Resources:

1. Technology Screening Guide for Treatment of CERCLA Soils and Sludges, Office of Solid waste and Emergency Response, EPA/540/2-88/004, September 1988.
2. Implementing Presumptive Remedies: A Notebook of Guidance and Resource Materials, Office of Solid Waste and Emergency Response, EPA-540-R-97-029, OSWER 9378.0-11, October 1997.
3. Presumptive Remedies for Soils, sediments, and Sludges at Wood Treater Sites, Office of Solid Waste and Emergency Response, EPA 540-R-95-128, OSWER 9200.5-162, December 1995b.

Appendix A: Cost Summaries for Screened Technologies

The Remedial Action Cost Engineering and Requirements (RACER®) System, Version 11.2.16.0 was used to estimate costs and assist with the comparison of alternatives relative to cost. RACER® is a program originally developed by the U.S. Air Force. The program is a parametric cost estimating tool specifically developed for environmental remediation and restoration projects. These estimates are based on current site data and characteristics related to the tank waste and the lead additive area. These estimates were not developed to be all inclusive, and are developed to support a screening level comparison between technologies. A summary of the cost estimates are provided in Table A-1 while printouts of supporting documentation provided through RACER® follow and are summarized in Table A-2.

All technologies will need to be combined with one or two other technologies to address the organic and inorganic source the technology does not address and any residual remaining. For all such instances, the estimates provided are specific to the source material addressed, and are summarized to indicate technologies considered. In addition, the table identifies remaining residual that needs to be addressed, and not summarized in the screening cost estimate.

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope. Changes in the cost elements are likely to occur as a result of new information and data collected during the design and planning for the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

In-Situ Land Farming is not practical or effective at the site because source material is greater than 2 feet deep.

Without a viable market and with the small volume of lead-bearing material at the site, reclamation does not warrant further consideration and cost estimation is not necessary.

Table A-1: Summary of Estimated Cost for Treatment Technologies Screened				
Technology	**Estimated Cost**	**Source Addressed**	**Summary of Components**	**Residual and/or Source Remaining**
Excavation – Immobilization Treatment	$4,135,294	Tank Waste Lead Additive Area	excavation/ treatment of metals/offsite disposal/documentation/5yr reviews	None
Vegetative Cap– Immobilization Treatment	$4,502,031	Tank Waste Lead Additive Area	excavation/treatment of metals/consolidation/cap construction/ICs/ documentation/maintenance/5-yr reviews	None
Geomembrane Cap – Immobilization Treatment	$4,633,269	Tank Waste Lead Additive Area	excavation/treatment of metals/consolidation/ cap construction/ICs/documentation/ maintenance/5-yr reviews	None
Onsite Incineration	$153,578,257	Tank Waste	excavation/incineration/documentation	Treated Residual (onsite disposal or offsite disposal) & Lead Additive Area
Onsite Low Thermal Desorption	$986,496,054	Tank Waste	excavation/thermal treatment/documentation	Treated Residual (onsite disposal or offsite disposal) & Lead Additive Area
Land Farming-Ex-situ-Immobilization Treatment	$4,572,578	Tank Waste Lead Additive Area	excavation/biological treatment/ treatment of metals/documentation	Treated Residual (onsite disposal or offsite disposal)
Reclamation	TBD	Lead Additive Area		Tank Waste

Table A-2: Cost Summary of Screened Alternative Components							
Alternative Components	**Component Cost**	**Excavate-Immobilization-Offsite Disposal**	**Excavate-Immobilization-Geomembrane Cap**	**Excavate-Immobilization-Vegetative Cap**	**Excavation and Thermal Desorption**	**Excavation and Incineration**	**Landfarm with Immobilization**
Excavation	$2,302,289	x	x	x			x
Offsite transport/Disposal	$1,366,048	x					
Capping-Vegetative	$699,145			x			
Capping-Geomembrane	$830,383		x				
Immobilization	$385,176	x	x	x			x
Demolish fencing	$3,226	x	x	x			x
Administrative Actions							
5-yr Reviews (Capping)	$53,475		x	x			
5-yr Reviews (excavation)	$51,170	x					x
Site Closeout Docs	$27,385	x	x	x	x	x	x
ICs/Annual monitoring/reports	$1,031,335		x	x			
Onsite Incineration	$151,410,420					x	
Onsite Thermal	$984,328,217				x		
Land Farming ex-situ	$1,803,332						x
Excavation (organics only)	$2,167,837				x	x	
Estimated Total Cost Screened		$4,135,294	$4,633,270	$4,502,031	$986,523,439	$153,605,642	$4,572,578

Phase Cost Summary Report
(with Markups)

System:

RACER Version: RACER® Version 11.2.16.0
Database Location: C:\Users\KHiggins\Documents\RACER 11.2\Racer.mdb

Folder:

Folder Name: Wilcox RI

Project:

ID: Wilcox Early Action
Name: Early Action
Category: None

Location
State / Country: OKLAHOMA
City: OKLAHOMA STATE AVERAGE

Location Modifier	Default	User	Reason for changes
	0.920	0.920	

Options
Database: System Costs
Cost Database Date: 2015
Report Option: Fiscal

Description: source removal

Phase Cost Summary Report
(with Markups)

Site:

ID: Wilcox
Name: Interim Action-Excavate-Treat-Offsite Disposal-all areas
Type: None

Media/Waste Type

Primary: Sediment/Sludge
Secondary: Soil

Contaminant

Primary: Semi-Volatile Organic Compounds (SVOCs)
Secondary: Metals

Phase Names

Pre-Study	☐
Study	☐
Design	☑
Removal/Interim Action	☑
Remedial Action	☑
Operations & Maintenance	☑
Long Term Monitoring	☐
Site Closeout	☑

Documentation

Description: reports
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Katrina Higgins-Coltrain
Estimator Title: RPM
Agency/Org./Office: EPA R6
Business Address: 1445 ross Ave, Dallas, 75202
Telephone Number: 2146658143
Email Address: coltrain.katrina@epa.g0v
Estimate Prepared Date: 04/03/2018

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Phase Cost Summary Report
(with Markups)

Email Address:
Date Reviewed: 04/03/2018

Reviewer Signature: _____ Date: _____

Phase Cost Summary Report
(with Markups)

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	excavation, treatment, offsite disposal
Description:	remediation
Approach:	Ex Situ
Start Date:	April, 2018
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markup Template:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Ex Situ Solidification/Stabilization	True	100	0
Excavation	True	100	0
Off-site Transportation and Waste Disposal	True	100	0
Demolition, Fencing	True	100	0
Site Close-Out Documentation	True	100	0
Five-Year Review	True	100	0

Total Marked-up Cost: $4,135,293.52

Technologies:

Phase Cost Summary Report
(with Markups)

Technology	Direct Cost	Markups	Total Cost
Demolition, Fencing	$2,153	$1,073	$3,226
Ex Situ Solidification/Stabilization	$276,438	$108,738	$385,176
Excavation	$1,537,687	$764,602	$2,302,289
Five-Year Review	$21,049	$30,121	$51,170
Off-site Transportation and Waste Disposal	$1,111,809	$254,239	$1,366,048
Site Close-Out Documentation	$9,846	$17,538	$27,385
Total Phase Cost	$2,958,983	$1,176,311	$4,135,294

Phase Cost Summary Report
(with Markups)

System:

RACER Version: RACER® Version 11.2.16.0
Database Location: C:\Users\KHiggins\Documents\RACER 11.2\Racer.mdb

Folder:

Folder Name: Wilcox RI

Project:

ID: Wilcox Early Action
Name: Early Action
Category: None

Location
State / Country: OKLAHOMA
City: OKLAHOMA STATE AVERAGE

Location Modifier	Default	User	Reason for changes
	0.920	0.920	

Options
Database: System Costs
Cost Database Date: 2015
Report Option: Fiscal

Description: source removal

Phase Cost Summary Report
(with Markups)

Site:

ID: Wilcox
Name: Interim Action-Excavate, Treat, Cap-all areas
Type: None

Media/Waste Type

Primary: Soil
Secondary: Sediment/Sludge

Contaminant

Primary: Semi-Volatile Organic Compounds (SVOCs)
Secondary: Metals

Phase Names

Pre-Study	☐
Study	☐
Design	☑
Removal/Interim Action	☐
Remedial Action	☑
Operations & Maintenance	☑
Long Term Monitoring	☑
Site Closeout	☑

Documentation

Description: documentation
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Katrina Higgins-Coltrain
Estimator Title: RPM
Agency/Org./Office: EPA R6
Business Address: 1445 ross Ave, Dallas, 75202
Telephone Number: 2146658143
Email Address: coltrain.katrina@epa.g0v
Estimate Prepared Date: 04/03/2018

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Phase Cost Summary Report
(with Markups)

Email Address:
Date Reviewed: 04/03/2018

Reviewer Signature: _____ Date: _____

Phase Cost Summary Report
(with Markups)

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	Capping
Description:	Capping
Approach:	Ex Situ
Start Date:	April, 2018
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markup Template:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Excavation	True	100	0
Ex Situ Solidification/Stabilization	True	100	0
Capping	True	100	0
Demolition, Fencing	True	100	0
Five-Year Review	True	100	0
Site Close-Out Documentation	True	100	0
ADMINISTRATIVE LAND USE CONTROLS	True	100	0

Total Marked-up Cost: $4,633,270.26

Technologies:

Phase Cost Summary Report
(with Markups)

Technology	Direct Cost	Markups	Total Cost
ADMINISTRATIVE LAND USE CONTROLS	$395,741	$635,594	$1,031,335
Capping	$554,165	$276,218	$830,383
Demolition, Fencing	$2,153	$1,073	$3,226
Ex Situ Solidification/Stabilization	$276,438	$108,738	$385,176
Excavation	$1,537,687	$764,602	$2,302,289
Five-Year Review	$21,878	$31,597	$53,475
Site Close-Out Documentation	$9,846	$17,538	$27,385
Total Phase Cost	$2,797,909	$1,835,361	$4,633,270

Phase Cost Summary Report
(with Markups)

System:

RACER Version: RACER® Version 11.2.16.0
Database Location: C:\Users\KHiggins\Documents\RACER 11.2\Racer.mdb

Folder:

Folder Name: Wilcox RI

Project:

ID: Wilcox Early Action
Name: Early Action
Category: None

Location
State / Country: OKLAHOMA
City: OKLAHOMA STATE AVERAGE

Location Modifier	Default	User	Reason for changes
	0.920	0.920	

Options
Database: System Costs
Cost Database Date: 2015
Report Option: Fiscal

Description: source removal

Phase Cost Summary Report
(with Markups)

Site:

ID: Wilcox
Name: Wilcox - treatments--updated 4-5-18
Type: None

Media/Waste Type

Primary: Sediment/Sludge
Secondary: Solids

Contaminant

Primary: Semi-Volatile Organic Compounds (SVOCs)
Secondary: Volatile Organic Compounds (VOCs)

Phase Names

- Pre-Study ☐
- Study ☐
- Design ☐
- Removal/Interim Action ☐
- Remedial Action ☑
- Operations & Maintenance ☐
- Long Term Monitoring ☐
- Site Closeout ☐

Documentation

Description: reports
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Katrina Higgins-Coltrain
Estimator Title: RPM
Agency/Org./Office: EPA R6
Business Address: 1445 ross Ave, Dallas, 75202
Telephone Number: 2146658143
Email Address: coltrain.katrina@epa.g0v
Estimate Prepared Date: 03/31/2017

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Phase Cost Summary Report
(with Markups)

Email Address:
Date Reviewed: 04/05/2018

Reviewer Signature: _____ Date: _____

Phase Cost Summary Report
(with Markups)

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	Wilcox Capping - evapotranspiration
Description:	New Phase
Approach:	Ex Situ
Start Date:	April, 2018
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markup Template:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Capping	True	100	0
Excavation	True	100	0
Five-Year Review	True	100	0
Demolition, Fencing	True	100	0
ADMINISTRATIVE LAND USE CONTROLS	True	100	0
Site Close-Out Documentation	True	100	0
Ex Situ Solidification/Stabilization	True	100	0

Total Marked-up Cost: $4,502,031.48

Technologies:

Phase Cost Summary Report
(with Markups)

Technology	Direct Cost	Markups	Total Cost
ADMINISTRATIVE LAND USE CONTROLS	$395,741	$635,594	$1,031,335
Capping	$466,731	$232,413	$699,145
Demolition, Fencing	$2,153	$1,073	$3,226
Ex Situ Solidification/Stabilization	$276,438	$108,738	$385,176
Excavation	$1,537,687	$764,602	$2,302,289
Five-Year Review	$21,878	$31,597	$53,475
Site Close-Out Documentation	$9,846	$17,538	$27,385
Total Phase Cost	$2,710,475	$1,791,556	$4,502,031

Phase Cost Summary Report
(with Markups)

System:

RACER Version: RACER® Version 11.2.16.0
Database Location: C:\Users\KHiggins\Documents\RACER 11.2\Racer.mdb

Folder:

Folder Name: Wilcox RI

Project:

ID: Wilcox Early Action
Name: Early Action
Category: None

Location
State / Country: OKLAHOMA
City: OKLAHOMA STATE AVERAGE

Location Modifier	Default	User	Reason for changes
	0.920	0.920	

Options
Database: System Costs
Cost Database Date: 2015
Report Option: Fiscal

Description: source removal

Phase Cost Summary Report
(with Markups)

Site:

ID: Wilcox
Name: Wilcox - treatments--updated 4-5-18
Type: None

Media/Waste Type

Primary: Sediment/Sludge
Secondary: Solids

Contaminant

Primary: Semi-Volatile Organic Compounds (SVOCs)
Secondary: Volatile Organic Compounds (VOCs)

Phase Names

- Pre-Study ☐
- Study ☐
- Design ☐
- Removal/Interim Action ☐
- Remedial Action ☑
- Operations & Maintenance ☐
- Long Term Monitoring ☐
- Site Closeout ☐

Documentation

Description: reports
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Katrina Higgins-Coltrain
Estimator Title: RPM
Agency/Org./Office: EPA R6
Business Address: 1445 ross Ave, Dallas, 75202
Telephone Number: 2146658143
Email Address: coltrain.katrina@epa.g0v
Estimate Prepared Date: 03/31/2017

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Phase Cost Summary Report
(with Markups)

Email Address:
Date Reviewed: 04/05/2018

Reviewer Signature: _____ Date: _____

Phase Cost Summary Report
(with Markups)

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	wilcox treatment - low thermal desorption
Description:	New Phase
Approach:	Ex Situ
Start Date:	August, 2018
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markup Template:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Excavation	True	100	0
On-site Low Temp. Thermal Desorption	True	100	0
Site Close-Out Documentation	True	100	0

Total Marked-up Cost: $986,523,438.61

Technologies:

Phase Cost Summary Report
(with Markups)

Technology	Direct Cost	Markups	Total Cost
Excavation	$1,453,257	$714,581	$2,167,837
On-site Low Temp. Thermal Desorption	$821,094,609	$163,233,608	$984,328,217
Site Close-Out Documentation	$9,846	$17,538	$27,385
Total Phase Cost	$822,557,712	$163,965,727	$986,523,439

Phase Cost Summary Report
(with Markups)

System:

RACER Version: RACER® Version 11.2.16.0
Database Location: C:\Users\KHiggins\Documents\RACER 11.2\Racer.mdb

Folder:

Folder Name: Wilcox RI

Project:

ID: Wilcox Early Action
Name: Early Action
Category: None

Location
State / Country: OKLAHOMA
City: OKLAHOMA STATE AVERAGE

Location Modifier	Default	User	Reason for changes
	0.920	0.920	

Options
Database: System Costs
Cost Database Date: 2015
Report Option: Fiscal

Description: source removal

Phase Cost Summary Report
(with Markups)

Site:

ID: Wilcox
Name: Wilcox - treatments--updated 4-5-18
Type: None

Media/Waste Type

Primary: Sediment/Sludge
Secondary: Solids

Contaminant

Primary: Semi-Volatile Organic Compounds (SVOCs)
Secondary: Volatile Organic Compounds (VOCs)

Phase Names

Pre-Study	☐
Study	☐
Design	☐
Removal/Interim Action	☐
Remedial Action	☑
Operations & Maintenance	☐
Long Term Monitoring	☐
Site Closeout	☐

Documentation

Description: reports
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Katrina Higgins-Coltrain
Estimator Title: RPM
Agency/Org./Office: EPA R6
Business Address: 1445 ross Ave, Dallas, 75202
Telephone Number: 2146658143
Email Address: coltrain.katrina@epa.g0v
Estimate Prepared Date: 03/31/2017

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Phase Cost Summary Report
(with Markups)

Email Address:
Date Reviewed: 04/05/2018

Reviewer Signature: _____ Date: _____

Phase Cost Summary Report
(with Markups)

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	Wilcox treatment - incineration
Description:	New Phase
Approach:	Ex Situ
Start Date:	August, 2018
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markup Template:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Excavation	True	100	0
On-site Incineration	True	100	0
Site Close-Out Documentation	True	100	0

Total Marked-up Cost: $153,605,641.59

Technologies:

Phase Cost Summary Report
(with Markups)

Technology	Direct Cost	Markups	Total Cost
Excavation	$1,453,257	$714,581	$2,167,837
On-site Incineration	$126,281,691	$25,128,729	$151,410,420
Site Close-Out Documentation	$9,846	$17,538	$27,385
Total Phase Cost	$127,744,794	$25,860,848	$153,605,642

Phase Cost Summary Report
(with Markups)

System:

RACER Version: RACER® Version 11.2.16.0
Database Location: C:\Users\KHiggins\Documents\RACER 11.2\Racer.mdb

Folder:

Folder Name: Wilcox RI

Project:

ID: Wilcox Early Action
Name: Early Action
Category: None

Location
State / Country: OKLAHOMA
City: OKLAHOMA STATE AVERAGE

Location Modifier	Default	User	Reason for changes
	0.920	0.920	

Options
Database: System Costs
Cost Database Date: 2015
Report Option: Fiscal

Description: source removal

Phase Cost Summary Report
(with Markups)

Site:

ID: Wilcox
Name: Wilcox - treatments--updated 4-5-18
Type: None

Media/Waste Type

Primary: Sediment/Sludge
Secondary: Solids

Contaminant

Primary: Semi-Volatile Organic Compounds (SVOCs)
Secondary: Volatile Organic Compounds (VOCs)

Phase Names

- Pre-Study ☐
- Study ☐
- Design ☐
- Removal/Interim Action ☐
- Remedial Action ☑
- Operations & Maintenance ☐
- Long Term Monitoring ☐
- Site Closeout ☐

Documentation

Description: reports
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: Katrina Higgins-Coltrain
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Estimate Prepared Date: 03/31/2017

Estimator Signature: _____ Date: _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:

Phase Cost Summary Report
(with Markups)

Email Address:
Date Reviewed: 04/05/2018

Reviewer Signature: _____ Date: _____

Phase Cost Summary Report
(with Markups)

Phase Documentation:

Phase Type:	Remedial Action
Phase Name:	Wilcox Treatment - Ex-situ Land farming - organics
Description:	New Phase
Approach:	Ex Situ
Start Date:	August, 2018
Labor Rate Group:	System Labor Rate
Analysis Rate Group:	System Analysis Rate
Phase Markup Template:	System Defaults

Technology Markups	Markup	% Prime	% Sub.
Ex Situ Land Farming	True	100	0
Site Close-Out Documentation	True	100	0
Demolition, Fencing	True	100	0
Five-Year Review	True	100	0
Ex Situ Solidification/Stabilization	True	100	0
Excavation	True	100	0

Total Marked-up Cost: $4,572,577.58

Technologies:

Phase Cost Summary Report
(with Markups)

Technology	Direct Cost	Markups	Total Cost
Demolition, Fencing	$2,153	$1,073	$3,226
Ex Situ Land Farming	$1,203,424	$599,907	$1,803,332
Ex Situ Solidification/Stabilization	$276,438	$108,738	$385,176
Excavation	$1,537,687	$764,602	$2,302,289
Five-Year Review	$21,049	$30,121	$51,170
Site Close-Out Documentation	$9,846	$17,538	$27,385
Total Phase Cost	$3,050,598	$1,521,979	$4,572,578